Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the above-captioned application.

Please cancel claims 8 and 30 without prejudice.

Listing of Claims:

1.-5. (Cancelled)

6. (currently amended) A method for producing a solid titanium catalyst for homo-polymerization and co-polymerization of ethylene, ~~wherein the catalyst is prepared by a method~~ comprising:

preparing a magnesium compound solution by contacting a magnesium halide compound with an alcohol;

preparing a second solution by reacting the magnesium compound solution with an ester compound comprising at least one hydroxy group and a first silicon compound, wherein the first silicon compound comprises a silicon compound having an alkoxy group; and

reacting the second solution with a mixture of a titanium compound and a second silicon compound to produce the solid titanium catalyst, the second silicon compound comprising a silicon halide.

7. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the produced solid titanium catalyst is further reacted with a second titanium compound.

Claim 8 (cancelled)

9. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises an unsaturated aliphatic ester having at least one hydroxy group.

10. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises 2-hydroxy ethylacrylate, 2-hydroxy ethylmethacrylate, 2-hydroxy propyl acrylate, 2-hydroxy propylmethacrylate, 4-hydroxy butylacrylate, or pentaerithritol triacrylate.

11. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises an aliphatic monoester having at least one hydroxy group or an aliphatic polyester having at least one hydroxy group.

12. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises 2-hydroxy ethyl acetate, methyl 3-hydroxy butylate, ethyl 3-hydroxy butylate, methyl 2-hydroxy isobutylate, ethyl 2-hydroxy isobutylate, methyl 3-hydroxy-2-methyl propionate, 2,2-dimethyl-3-hydroxy propionate, ethyl-6-hydroxy hexanoate, t-butyl-2-hydroxy isobutylate, diethyl-3-hydroxy glutarate, ethyllactate, isopropyl lactate, butyl-isobutyl lactate, isobutyl lactate, ethyl mandelate, dimethyl ethyl tartrate, ethyl tartrate, dibutyl tartrate, diethyl citrate, triethyl citrate, ethyl-2-hydroxy-caproate, or diethyl *bis*-(hydroxymethyl) malonate.

13. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises an aromatic ester having at least one hydroxy group.

14. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises 2-hydroxy ethyl benzoate, 2-hydroxy ethyl salicylate, methyl-4-(hydroxy methyl) benzoate, methyl-4-hydroxy benzoate, ethyl-3-hydroxy benzoate, 4-methyl salicylate, ethyl salicylate, phenyl salicylate, propyl-4-hydroxy benzoate, phenyl-3-hydroxy naphthanoate, monoethylene glycol monobenzoate, diethylene glycol benzoate, or triethylene glycol monobenzoate.

15. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises an alicyclic ester having at least one hydroxy group.

16. (cancelled)

17. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the first silicon compound comprises the general formula $R^1_nSi(OR^2)_{4-n}$, wherein R^1 comprises a hydrocarbon having between 1 to 12 carbons, wherein R^2 comprises a hydrocarbon having between 1 to 12 carbons, and wherein n comprises an integer between 0 and 3.

18. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the first silicon compound comprises dimethyldimethoxy silane, dimethyldiethoxy silane, diphenyldimethoxy silane, methylphenyldimethoxy silane, diphenyldiethoxy silane, ethyltrimethoxy silane, vinyltrimethoxy silane, methyltrimethoxy silane, phenyltrimethoxy silane, methyltriethoxy silane, ethyltriethoxy silane, vinyltriethoxy silane, butyltriethoxy silane, phenyltriethoxy silane, ethyltriisopropoxy silane, vinyltributoxy silane, ethylsilicate, butylsilicate, or methyltriaryloxy silane.

19. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the titanium compound comprises the general formula $Ti(OR)_aX_{4-a}$, wherein R comprises an alkyl group with 1 to 20 carbon atoms, wherein X comprises a halogen atom, and wherein a comprises an integer between 0 and 4.

20. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the titanium compound comprises a titanium tetrahalide, wherein the titanium tetrahalide comprises $TiCl_4$, $TiBr_4$, or TiI_4.

21. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the titanium compound comprises an alkoxy-titanium trihalide, wherein the alkoxy-titanium trihalide comprises $Ti(OCH_3)Cl_3$, $Ti(OC_2H_5)Cl_3$, $Ti(OC_2H_5)Br_3$, or $Ti(O(i\text{-}C_4H_9))Br_3$.

22. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the titanium compound comprises an alkoxy-titanium dihalide, wherein the alkoxy-titanium dihalide comprises $Ti(OCH_3)_2Cl_2$, $Ti(OC_2H_5)_2Cl_2$, $Ti(OC_2H_5)_2Br_2$, or $Ti(O(i\text{-}C_4H_9))_2Cl_2$.

23. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the titanium compound comprises a tetraalkoxy-titanium compound, wherein the tetraalkoxy-titanium compound comprises $Ti(OCH_3)_4$, $Ti(OC_2H_5)_4$, or $Ti(OC_4H_9)_4$.

24. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the second silicon compound comprises the general formula R_nSiCl_{4-n}, wherein R comprises hydrogen, or R comprises an alkyl group, an alkoxy group, a haloalkyl group, or an aryl group having 1 to 10 carbon atoms, or R comprises a halosilyl group or a halosilyl alkyl group having 1 to 8 carbon atoms, and wherein n comprises an integer between 0 and 4.

25. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the second silicon compound comprises silicon tetrachloride.

26. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the second silicon compound comprises a trichlorosilane, wherein the trichlorosilane comprises methyltrichlorosilane, ethyltrichlorosilane, or phenyl-trichlorosilane.

27. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the second silicon compound comprises a dichlorosilane, wherein the dichlorosilane comprises dimethyldichlorosilane, diethyldichlorosilane, diphenyldichlorosilane, or methylphenyldichlorosilane.

28. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the second silicon compound comprises trimethylchlorosilane.

29. (currently amended) The method for producing a solid titanium catalyst of claim 6, wherein the ester compound comprises 2-hydroxyethyl methacrylate, wherein the first silicon compound comprises silicon tetraethoxide, wherein the titanium compound comprises titanium tetrachloride, and wherein the second silicon compound comprises silicon tetrachloride.

Claims 30-31 (cancelled)

32. (currently amended) The method of producing a solid titanium catalyst of claim 6, wherein an amount of the mixture of the titanium compound and the second silicon compound is about 0.1 moles per mole of the magnesium halide compound to about 200 moles per mole of the

magnesium halide compound, and wherein a molar ratio of the titanium compound to the second silicon compound in the mixture is between about 0.05 and about 0.95.

Response to Office Action Mailed November 28, 2003

A. Claims in the Case

Claims 6-15, 17-30 and 32 are rejected. Claims 6, 7, 9-15, 17-29 and 32 are pending. Claims 8 and 30 have been cancelled without prejudice. Claims 6, 7, 9-15, 17-29 and 32 have been amended. Former independent claim 30 has been rewritten as amended claim 6.

B. The Claims Are Not Anticipated by Toida et al. et al. Pursuant To 35 U.S.C. § 102(a)

The Examiner rejected claims 6-15, 17-29 and 32 under 35 U.S.C. § 102(a) as being unpatentable over U.S. Patent No. 5,877,265 to Toida et al. (hereinafter "Toida").

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

In the Office Action, the Examiner stated that "[w]hile the catalyst of Toida is not made by the same process, the catalyst made is the same as the claimed catalyst." (Office Action, page 3)

Amended claim 6 describes "a method for producing a solid titanium catalyst". Amended Claim 6 includes a combination of features including, but not limited to, the features of "preparing a second solution by reacting the magnesium compound solution with an ester compound comprising at least one hydroxy group and a first silicon compound, wherein the first

silicon compound comprises a silicon compound having an alkoxy group." Applicant submits that the cited art does not appear to teach or suggest at least the quoted features of claim 6.

Toida teaches "contacting the magnesium compound solution with a compound having at least two ether linkages existing through a plurality of atoms." (Toida, column 2, lines 47-49) Toida appears to teach producing a catalyst by contacting a magnesium compound with a compound having at least two ether linkages. Toida does not appear to teach or suggest producing a catalyst by preparing a second solution by reacting the magnesium compound solution with an ester compound and a first silicon compound. The Examiner appears to agree, stating "the catalyst of Toida is not made by the same process." (Office Action, page 3)

Applicant submits that the cited art does not teach or suggest all of the features of independent claim 6 and the claims dependent thereon. Applicant respectfully requests removal of the rejections to the claims.

Furthermore, Toida appears to be related to a process for production of a solid titanium catalyst component used as a main catalyst in olefin polymerization, characterized by using a polyether compound having at least two ether linkages existing through a plurality of atoms in the molecule, in addition to the conventional magnesium and titanium compounds.

Toida, appears to describe a process of preparing a solid titanium catalyst including:

> a) contacting a halogenated magnesium compound with an electron donor (not the following polyether compound) in a hydrocarbon solvent to obtain a magnesium compound solution;
> (b) contacting the magnesium compound solution with a polyether compound to prepare a magnesium polyether solution; and

(c) reacting the magnesium polyether solution with a liquid titanium compound to prepare a titanium solid catalyst.

Polymers prepared using the catalyst system disclosed by Toida have uniform particle size and high melt index and stereoregularity.

The preparation method of the catalyst according to Applicant's claims is different from that of Toida in the following respects:

(i) In the present claims, a magnesium compound solution, obtained by reacting a magnesium compound with an alcohol, is reacted with an ester compound having at least one hydroxy group and a first silicon compound having an alkoxy group (step (b)). However, in the preparation process of the catalyst according to Toida, et al., the magnesium compound solution, obtained by reacting a magnesium compound with an alcohol, is contacted with a polyether compound to prepare a magnesium polyether solution. There does not appear to be any mention of the use of an ester compound having at least one hydroxy group and a first silicon compound having an alkoxy group.

Meanwhile, according to Toida, it is described that an alcohol, ether or ester may be used as an electron donor in the step of reacting a magnesium compound with an alcohol to prepare a magnesium compound solution. Also, many types of electron donors which may be used in the preparation of the solid titanium catalyst are listed. However, there is no concrete description as to which of these electron donors should be selected in order to produce a catalyst having high catalytic activity and hydrogen sensitivity, and further is capable of producing polymers of good bulk density. Also, although in the polyether compound cited by Toida the plurality of atoms may be at least one selected from the group consisting of carbon, silicon, oxygen, nitrogen, phosphorus,

boron and sulfur atoms, the silicon containing compounds are merely mentioned since the silicon atom is one of a class of multi-valenced atoms that may constitute the polyether compound, and it is not described in the specification of Toida that a silicon containing polyether compound should be specifically selected. Also, in "Preparation of solid titanium catalyst component (A)" of the Examples by Toida, there is no example in which either an ester compound having at least one hydroxy group or a silicon compound having an alkoxy group was used. Admittedly, there is a description of use of an alkoxy silane compound in the olefin polymerization in Toida, but in this case, it is used as an external electron donor which is used in the olefin polymerization process, unrelated to the process for producing a main catalyst component, and thus, this is outside comparison with the main catalyst component according to the present claims.

As described above, no such description appears to be present in the Specification of Toida that may anticipate the features of the present claims, including but not limited to, using an ester compound having at least one hydroxy group and a first silicon compound having an alkoxy group.

(ii) The present claims include, but are not limited to reacting, in step (b), the magnesium solution, obtained by reacting a magnesium compound with an alcohol, with an ester compound having at least one hydroxy group and a first silicon compound having an alkoxy group to prepare a second solution, and afterwards, in step (c) producing a solid titanium catalyst by reacting the second solution with a titanium compound and a second silicon compound including a silicon halide. There does not appear to be any such construction disclosed in Toida.

In such olefin polymerization catalysts, such as solid titanium catalysts, their catalytic activities and the properties of the polymer produced by them depend upon the

structural characteristics of the catalysts themselves. Therefore, such factors of the electron donors as types, structures, sizes, order of introduction, numbers and the like which affect the structure of the catalyst, are factors that may determine the properties of the resultant polymers.

The Examiner pointed out in the Office Action that if the resulting product is the same with that of the cited art, it is considered that the claims are obvious from the cited art, although the production method is different since the present claims relate to an article, not to a production process. Applicant respectfully disagrees with the Examiner's comments, however to expedite prosecution, the claims have been amended to be directed to a method for preparing a catalyst.

Also, in the embodiments of Applicant's methods, both the first silicon compound and the second silicon compound are electron donors but have different structures from each other. One of them is a silicon compound having an alkoxy group while the other is a silicon compound including a silicon halide.

An organic compound used as an electron donor should have an element capable of donating an electron, that is, an element having an electron lone pair(s) in the molecule. Typical electron donating elements include oxygen, nitrogen, sulfur, phosphorous, halogen, etc. However, these elements have different attraction forces of the atomic nucleus for the electron lone pair, which indicates that their abilities to donate electron are different. Therefore, the type of the element substantially donating an electron in an electron donor molecule is a factor that will determine the ability of the compound to donate electrons. Also, since these elements are bonded to certain other functional groups and exist as being bonded to other elements, the attraction force of the atomic nucleus for the electron lone pair, i. e., the ability to donate electrons, may vary according to the functional group or the type

of the other elements bonded to the nucleus. Thus, the type of functional group donating electrons in the electron donor compound molecule is also a factor in determining the electron donating abilities.

Therefore, in order to judge whether an electron donor included in the catalyst composition is obvious from the prior art, the compound should be judged not only based on the typical type of the compound but also based on the type of the element substantially donating electrons in the electron donor compound molecule and the type of functional groups bound to the element.

Applicants claims are include, but are not limited to the feature of using two different types of silicon compounds. In the first silicon compound, the element substantially donating electrons in the molecule is oxygen, while in the second silicon compound the element substantially donating electrons is a halogen atom. That is, the first and the second silicon compound are different compounds having different electron donating ability. The use of a compound having different electron donating abilities from the first silicon compound as a second silicon compound is one of the features of Applicant's claims.

As described above, in the specification of Toida, there is no description anticipating the all of the features of the claims, including, but not limited to, the introduction of a first silicon compound having an alkoxy group, prior to the introduction of a second silicon compound containing a silicon halide.

(iii) Toida appears to teach that an alkoxy silane compound does not react with the titanium compound during the process of preparing a main catalyst component but, instead, when it is added together with the main catalyst component in the stage of

polymerization, the titanium compound in the main catalyst component reacts with the alkoxy silane compound. This may be seen from the fact that no mention appears to be made of the use of an alkoxy silane compound in the part `Preparation of solid titanium catalyst component(A)' of the examples in the Specification of Toida, and the addition and use of an alkoxy silane compound is included only in the part on the `Polymerization' process.

Applicant's claims are directed to a method for preparing a solid titanium main catalyst component, for instance, only the part "Preparation of solid titanium catalyst component (A)" of the embodiment examples described in the specification of Toida is to be compared with the present claims, and its "Polymerization" process, where cocatalyst components are used, is not relevant to Applicant's claims. Therefore, the use of an alkoxy silane compound of Toida, cannot be compared with the Applicant's claims which relate to a method for preparing a main catalyst component alone.

(iv) A catalyst prepared according to the method of Applicant's claims has high hydrogen sensitivity and, when it is used in a polymerization process, it is possible to produce a polymer of high bulk density. However, as described above, the specification of Toida does not appear to anticipate that both the hydrogen sensitivity of the catalyst and the bulk density of the resultant polymer by the catalyst will be high. Applicant submits that Toida does not anticipate the close interrelation between a specific construction of a process for preparing a catalyst on the one hand and both the hydrogen sensitivity of the catalyst and the bulk density of the resultant polymer by the catalyst on the other.

As has been discussed above, Toida does not appear to teach or suggest all of the features of Applicant's claims. Toida does not appear to mention the materials used in the process of the present claims; and the method for preparing a main catalyst by Toida is

different from the method for preparing a main catalyst according to the present claims. Therefore, it is not considered that the Applicant's claims are anticipated by Toida. Furthermore, the technical idea that a catalyst with high catalytic activity and hydrogen sensitivity and a polymer with good bulk density may be prepared by the method according to the Applicant's claims is not anticipated by the Toida.

The Examiner also stated "[w]ith respect to the metal concentrations and molar rations in claim 32, it appears met by the teaching of the reference (see Toida at col. 26, lin 20-27 & ln 47-54)." (Office Action, page 3)

Claim 32 includes a combination of features including, but not limited to, the features of

> wherein an amount of the mixture of the titanium compound and the second silicon compound is about 0.1 moles per mole of the magnesium halide compound to about 200 moles per mole of the magnesium halide compound, and wherein a molar ratio of the titanium compound to the second silicon compound in the mixture is between about 0.05 and about 0.95.

Toida does not teach the use of a second silicon compound in the preparation of a catalyst, and so Toida does not appear to teach or suggest a molar ratio between titanium compound and second silicon compound in the mixture. Applicant submits that at least the quoted features of claim 32 do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 32.

C. <u>The Claims Are Not Anticipated by Lee et al. et al. Pursuant To 35 U.S.C. § 102(e)</u>

The Examiner rejected claims 6-15, 17-30, and 32 under 35 U.S.C. § 102(e) as being unpatentable over U.S. Patent No. 6,291,385 to Lee et al. (hereinafter "Lee").

The Examiner stated "Lee discloses the claimed solid titanium catalyst and its method of production, thus anticipates the claims." (Office Action, page 4)

Claim 6 includes a combination of features including, but not limited to, the features of:

> preparing a magnesium compound solution by contacting a magnesium halide compound with an alcohol;
>
> preparing a second solution by reacting the magnesium compound solution with an ester compound comprising at least one hydroxy group and a first silicon compound, wherein the first silicon compound comprises a silicon compound having an alkoxy group; and
>
> reacting the second solution with a mixture of a titanium compound and a second silicon compound to produce the solid titanium catalyst, the second silicon compound comprising a silicon halide.

Lee teaches:

> The catalyst of the present invention is produced by (1) producing a liquid magnesium solution by reacting a mixture of a magnesium compound and an aluminum compound with alcohol in a solvent of inert hydrocarbon. (Lee, column 2, lines 20-23).

Lee does not appear to teach or suggest all the features of claim 6 or the claims dependent thereon.

Furthermore, the catalyst prepared according to claim 6 has high hydrogen sensitivity and when used in polymerization, produces a polymer of high bulk density. Applicant's Specification states:

> The catalyst of superior catalytic activity and hydrogen sensitivity, capable of producing polymers having high bulk density as provided in the present invention, is produced by a simple yet efficient manufacturing process, which comprises (i) preparing a magnesium solution by contact-reacting a magnesium halide compound, with an alcohol, (ii) reacting the same with an ester compound containing at least one hydroxy group and a silicon compound containing an alkoxy group, and (iii) producing a solid titanium catalyst by adding a titanium compound and a silicon compound. (Applicant's Specification, page 3, lines 19-25)

Lee does not appear to disclose a process for preparing a catalyst with high hydrogen sensitivity that produces a polymer of high bulk density when used in polymerization. Applicant submits that Lee does not appear to teach or suggest all the features of the claims. Applicant respectfully requests removal of the rejections to the claims.

The Examiner stated "applicants have not explained or provided the reasons as to how the addition of the second silicon compound (or more silicon compound) in the last step would result in a catalyst having a different structure than that of Lee's." (Office Action, page 5)

In olefin polymerization catalysts, the catalytic activities and the properties of the polymer produced by the catalysts depend upon the structural characteristics of the catalysts themselves. Therefore, factors such as electron donors types, structures, sizes, order of introduction, numbers, etc. affect the structure of the catalyst. In the method of claim 6, both the first silicon compound and the second silicon compound are electron donors but they are different from each other because the first silicon compound comprises an alkoxy group and the second silicon compound comprises a silicon halide.

An organic compound used as an electron donor should have an element capable of donating an electron. Elements capable of donating electrons include oxygen, nitrogen, sulfur, phosphorus, halogen, etc. Each of these elements has different attraction forces between the

atomic nucleus and the lone electron pair, which affects the ability to donate an electron. Therefore, an important factor in determining the ability of that compound to donate an electron is the type of element substantially donating an electron in an electron donor molecule. Furthermore, since the electron donating elements exist bonded to other elements, the attractive force of the atomic nucleus for the lone electron pair may vary according to the functional groups or the types of other elements the electron donating element is bonded with. Therefore, in order to judge whether an electron donor included in a catalyst is obvious over cited art, the compound should be judged not only based on the typical type of the compound but also based on the type of element substantially donating an electron and the type of functional group bonded to the electron donating element.

In the first silicon compound of claim 6, the element substantially donating an electron is oxygen and the element substantially donating an electron in the second silicon compound is a halogen. The first and second silicon compounds are different compounds and have different electron donating abilities. Therefore, in the method of claim 6 the use of a first silicon compound with a different electron donating ability from the second silicon compound does not appear to be taught or suggested by the cited art. In addition, the second silicon compound is not added because the amount of first silicon compound was insufficient. The cited art does not appear to teach or suggest the use of two silicon compounds with different electron donating abilities.

Additionally, Applicant's claims are directed, in part, to the formation of a catalyst having high hydrogen sensitivity and when the catalyst is used in polymerization, it is possible to produce a polymer of high bulk density using the catalyst. However, as described above, the specification of Lee, does not appear to teach or suggest a process for preparing a catalyst having these properties.

Applicant submits that the cited art does not teach or suggest all of the features of independent claim 6 and the claims dependent thereon. Applicant respectfully requests removal of the rejections to the claims.

D. Summary

Applicant submits that all claims are in condition for allowance. Favorable reconsideration is respectfully requested.

Applicant believes no fees are due with the submission of this amendment and response. If any extension of time is necessary, Applicant hereby requests the appropriate extension of time. If any fees are inadvertently omitted or if any fees are required, please charge those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5333-02500/EBM

Respectfully submitted,

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